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Report
on
White River Reservoir
Crosby County
Texas
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Working Paper No. 667

With the cooperation of the
Texas Water Quality Board
and the
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March, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Texas Water Quality Board for professional involvement, to the Texas National Guard for conducting the tributary sampling phase of the Survey, and to those Texas wastewater treatment plant operators who voluntarily provided effluent samples.

Hugh C. Yantis, Jr., Executive Director of the Texas Water Quality Board, and John B. Latchford, Jr., Director, and the staff of the Field Operations Division provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Thomas Bishop, the Adjutant General of Texas, and Project Officer Colonel William L. Seals, who directed the volunteer efforts of the Texas National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of Texas

NAME	COUNTY
Amistad	Val Verde
Bastrop	Bastrop
Belton	Bell, Coryell
Braunig	Bexar
Brownwood	Brown
Buchanan	Burnet, Llano
Caddo	Harrison, Marion, TX; Caddo Parish, LA
Calaveras	Bexar
Canyon	Comal
Colorado City	Mitchell
Corpus Christi	Jim Wells, Live Oak, San Patricio
Diversion	Archer, Baylor
Eagle Mountain	Tarrant, Wise
Fort Phantom Hill	Jones
Houston	Harris
Kemp	Baylor
Lake O'The Pines	Camp, Marion, Morris, Upshur
Lavon	Collin
Lewisville (Garza-Little Elm)	Denton
Livingston	Polk, San Jacinto, Trinity, Walker

Lyndon B. Johnson	Burnet, Llano
Medina	Bandera, Medina
Meredith	Hutchinson, Moore, Potter
O. C. Fisher (San Angelo)	Tom Green
Palestine	Anderson, Cherokee, Henderson, Smith
Possum Kingdom	Palo Pinto, Stephens, Young
Sam Rayburn	Angelina, Jasper Nacogdoches, Sabine, San Augustine
Somerville	Burleson, Lee, Washington
E. V. Spence	Coke
Stamford	Haskell
Stillhouse Hollow	Bell
Tawakoni	Hunt, Rains, Van Zandt
Texoma	Cooke, Grayson TX; Bryan, Johnston, Love, Marshall, OK
Travis	Burnet, Travis
Trinidad	Henderson
Twin Buttes	Tom Green
White River	Crosby
Whitney	Bosque, Hill
Wright Patman (Texarkana)	Bowie, Cass

WHITE RIVER RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
Scale
Map Location

WHITE RIVER RESERVOIR

STORET NO. 4838

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that White River Reservoir is meso-eutrophic; i.e., moderately well supplied with nutrients and productive. Whether nutrient enrichment is beneficial or deleterious depends on the actual or potential effect on the uses of the reservoir. In this regard, no nuisance conditions are known to personnel of the Texas Water Quality Board and there is little or no impairment of the designated beneficial uses of this water body.

White River Reservoir ranked eighth when the 39 Texas reservoirs sampled in 1974 were compared using a combination of six water quality parameters*. Six of the water bodies had less median total phosphorus, ten had less and six had the same median dissolved orthophosphorus, 14 had less and two had the same median inorganic nitrogen, four had less mean chlorophyll a, and nine had greater Secchi disc transparency. Marked depression or depletion of hypolimnetic dissolved oxygen occurred at all three sampling stations in August.

Survey limnologists noted submerged vegetation along much of the shoreline. This problem was noted in a previous report on this water body (Bamberg, 1974).

* See Appendix A.

B. Rate-Limiting Nutrient:

Due to significant nutrient losses in the samples during shipment, the algal assay results are not considered representative of conditions in the reservoir at the time of sampling. However, the reservoir data indicate nitrogen limitation at all stations in March, phosphorus limitation at all stations in May, and nitrogen limitation at stations 2 and 3 and phosphorus limitation at station 1 in November.

C. Nutrient Controllability:

1. Point sources--Septic tanks serving lakeshore dwellings were estimated to have contributed 3.3% of the total phosphorus input during the sampling year, but a shoreline survey would be necessary to determine the significance of those sources. However, a municipal point source outside the 40-kilometer Survey limit* (the City of Plainview) may be a significant contributor to the total nutrient load during periods of heavy rainfall and subsequent high runoff.

The present phosphorus loading of 0.06 g/m^2/year is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic loading (see page 13). Elimination of septic tank phosphorus loads probably would not result in an appreciable improvement in the trophic condition of the reservoir. Because this water-body has such a long hydraulic reten-

* See Working Paper No. 175, "...Survey Methods, 1973-1976".

tion time, 12.8 years, nutrients would tend to accumulate and continually recycle within the reservoir after they are washed out of the drainage basin during heavy rainfall. Further investigation is needed to determine the nutrient contribution of the upstream point source during the periods of high runoff.

2. Non-point sources--Non-point sources contributed an estimated 96.7% of the total phosphorus load during the sampling year. Although the White River contributed 66.3% of the total load, the phosphorus export rate of this stream was very low (see page 12).

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 7.32 kilometers².
2. Mean depth: 6.5 meters.
3. Maximum depth: >11.6 meters.
4. Volume: 47,580 x 10^6 m^3.
5. Mean hydraulic retention time: 12.8 years.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
White River	1,906.2	0.482
Minor tributaries & immediate drainage -	93.7	0.019
Totals	1,999.9	0.501

2. Outlets -

White River	2,007.2**	0.0**
Water-supply aqueduct	0.0	0.118***
Totals	2,007.2	0.118

C. Precipitation****:

1. Year of sampling: 78.3 centimeters.
2. Mean annual: 53.4 centimeters.

† Table of metric conversions--Appendix B.
†† Latchford, 1974.
* For limits of accuracy, see Working Paper No. 175.
** Includes area of reservoir; minimal outflow during the sampling year.
*** Anonymous, 1974.
**** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

White River Reservoir was sampled four times in 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at three stations on the lake (see map, page vi). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and fourth visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 11.6 meters at station 1, 7.9 meters at station 2, and 7.9 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table (the August nutrient samples were not preserved properly and were not analyzed).

[illegible]

[illegible]	1ST SAMPLING : [illegible]			2ND SAMPLING : [illegible]			3RD SAMPLING : [illegible]		
	3 SITES			3 SITES			3 SITES		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	28.0 - 33.1	[illegible]	28.2	25.8 - 25.9	25.9	25.9	26.7 - 26.2	25.4	26.1
[illegible]	6.8 - 8.4	8.1	8.2	6.8 - 7.0	7.3	7.4	6.8 - 7.8	8.1	8.2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	8.5 - 8.5	8.5	8.5	8.5 - 8.8	8.8	8.8	7.8 - 8.4	8.2	8.2
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	2.1 - 3.2	2.4	2.6	1.8 - 1.3	1.1	1.2	1.8 - 1.1	1.4	1.6
[illegible]	1.8 - 3.1	2.4	2.7	1.8 - 1.7	1.2	1.3	1.5 - 2.1	1.8	1.8

[illegible]

[illegible]

[illegible]

3 SITES

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	17.3 - 17.7	17.5	17.5
[illegible]	5.8 - 6.3	6.1	7.2
[illegible]	572. - 581.	576.	576.
[illegible]	6.1 - 6.3	6.2	6.3
[illegible]	187. - 194.	191.	194.
[illegible]	0.824 - 0.837	0.831	0.822
[illegible]	0.806 - 0.819	0.812	0.802
[illegible]	0.850 - 0.866	0.853	0.858
[illegible]	0.054 - 0.125	0.098	0.076
[illegible]	0.468 - 1.489	0.542	0.588
[illegible]	0.108 - 0.148	0.133	0.128
[illegible]	0.458 - 1.488	0.674	0.556
[illegible]	3.3 - 7.1	5.7	9.4
[illegible]	0.5 - 1.2	1.0	0.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/06/74	1. Chlamydomonas sp.	6,692
	2. Chroomonas sp.	689
	3. Aphanizomenon sp.	170
	4. Fragilaria sp.	67
	5. Oocystis sp.	42
	Other genera	60
	Total	7,720
05/14/74	1. Chroomonas sp.	250
	2. Chlamydomonas sp.	156
	3. Ankistrodesmus sp.	125
	4. Aphanizomenon sp.	94
	5. Cosmarium sp.	94
	Other genera	62
	Total	781
08/06/74	1. Pennate diatoms	1,326
	2. Aphanocapsa sp.	489
	3. Chroomonas sp.	384
	4. Cryptomonas sp.	209
	5. Anabaena sp.	70
	Other genera	383
	Total	2,861
10/26/74	1. Chroomonas sp.	1,086
	2. Aphanizomenon sp.	965
	3. Cyclotella sp.	367
	4. Melosira sp.	281
	5. Cryptomonas sp.	201
	Other genera	482
	Total	3,377

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
03/06/74	1	3.0
	2	2.1
	3	2.6
05/14/74	1	1.0
	2	0.8
	3	1.3
08/06/74	1	7.6
	2	7.0
	3	9.1
10/28/74	1	3.3
	2	6.8
	3	7.1

C. Limiting Nutrient Study:

The algal assay results are not considered representative of conditions in the reservoir due to significant nutrient losses in the samples during shipment from the field to the laboratory.

The reservoir data indicate a combination of limiting nutrients. Following is a tabulation of the mean inorganic nitrogen/orthophosphorus ratios for each of the sampling stations and times with the indicated limiting nutrient in parentheses.

Station	03/06/74	05/14/74	10/28/74
1	6/1 (N)	15/1 (P)	19/1 (P)
2	7/1 (N)	20/1 (P)	8/1 (N)
3	9/1 (N)	26/1 (P)	9/1 (N)

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Texas National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi). Sampling was begun in September, 1974, and was completed in August, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Texas District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in the White River at station A-2 and the mean annual ZZ flow.

A. Waste Sources:

1. Known municipal - None within the Survey 40-kilometer limit.

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
White River	305	66.3
b. Minor tributaries & immediate drainage (non-point load) -	10	2.2
c. Known municipal STP's -	7	-
d. Septic tanks* -	15	3.3
e. Known industrial - None	-	-
f. Direct precipitation** -	130	28.2
Total	460	100.0

2. Outputs -

Lake outlets -	White River	<5
	Aqueduct	60
	Total	<65

3. Net annual P accumulation - 400 kg.

* Estimate based on 50 lakeshore dwellings (Wyatt, 1976); see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
White River	12,115	57.6
b. Minor tributaries & immediate drainage (non-point load) -	480	2.3
c. Known municipal STP's -	7	-
d. Septic tanks* -	535	2.5
e. Known industrial - None	-	-
f. Direct precipitation** -	7,905	37.6
Total	21,035	100.0

2. Outputs -

Lake outlets -	White River	40
	Aqueduct	3,485
	Total	3,525

3. Net annual N accumulation - 17,510 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
White River	<1	6

* Estimate based on 50 lakeshore dwellings (Wyatt, 1976); see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.06	0.05	2.9	2.4

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of White River Reservoir:

"Dangerous" (eutrophic loading)	0.14
"Permissible" (oligotrophic loading)	0.07

V. LITERATURE REVIEWED

Anonymous, 1974. Water resources data for Texas, 1974. Part 1: Water records. U.S. Geol. Surv., Austin.

Bamberg, Roy M., 1974. Fisheries management recommendations. Fed. Aid Proj. F-17-R-10, TX Parks & Wildlife Dept., Austin.

Latchford, John B., Jr., 1974. Personal communication (reservoir morphometry). TX Water Qual. Bd., Austin.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

Wyatt, Linda B., 1976. Personal communication (number of lakeshore dwellings). TX Water Qual. Bd., Austin.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	[illegible] TOTAL P	[illegible] DISS P	[illegible] SEC	[illegible] DEPTH	[illegible]	[illegible] STR SHORE P
[illegible]	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]

[illegible] DATA TO BE USED IN [illegible]

LAKE CODE	LAKE NAME	[illegible] TOTAL P	[illegible] INORG P	SRP [illegible] SEC	[illegible] CHLOR	[illegible] APR 10	[illegible] 10cm DEPTH
[illegible]	SOMERVILLE LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	STAMFORD LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	STILLHOUSE [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	TAWAKONI LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	TEXOMA LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	TEXOMA LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	TWIN BUTTES LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	TWIN BUTTES [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	WHITE KING [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	WHITNEY LAKE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	SUM MEAN SEC	MEAN CHLORA	1ST MEAN AS	MEDIAN SECCHI P	PAGE NO
401	[illegible] LAKE	45 (36)	5 (2)	188 (38)	126 (26)	29 (94)	43 (23)	402
402	[illegible] LAKE	76 (38)	74 (29)	62 (31)	47 (18)	17 (0)	92 (34)	343
403	[illegible] RESERVOIR	92 (35)	26 (12)	97 (37)	68 (26)	17 (0)	84 (32)	384
404	[illegible] LAKE	5 (2)	42 (16)	58 (19)	0 (0)	48 (17)	5 (2)	154
405	[illegible] LAKE	66 (25)	78 (29)	29 (11)	87 (33)	58 (22)	84 (32)	396
406	LAKE [illegible]	47 (18)	21 (7)	74 (28)	63 (24)	17 (0)	34 (13)	261
407	[illegible] LAKE	26 (10)	91 (33)	42 (16)	32 (12)	76 (29)	38 (10)	247
408	[illegible] LAKE	45 (17)	100 (38)	47 (18)	11 (4)	67 (25)	92 (34)	362
409	[illegible] RESERVOIR	99 (37)	0 (0)	95 (36)	97 (37)	48 (17)	97 (37)	445
410	LAKE [illegible] CITY	39 (14)	76 (29)	25 (10)	42 (16)	88 (33)	38 (14)	310
411	[illegible] CREEK LAKE	0 (0)	47 (18)	18 (7)	13 (5)	61 (23)	0 (0)	155
412	[illegible] LAKE	68 (26)	63 (24)	22 (12)	29 (11)	97 (37)	63 (23)	372
413	EAGLE [illegible] LAKE	71 (27)	91 (33)	34 (13)	79 (30)	78 (30)	76 (28)	430
414	FT [illegible] HILL LAKE	24 (9)	66 (25)	21 (8)	74 (28)	95 (36)	16 (6)	246
415	GARZA LITTLE ELM RESERVO	34 (13)	13 (5)	16 (6)	34 (13)	55 (21)	21 (7)	173
416	[illegible] LAKE	76 (29)	61 (23)	55 (21)	55 (21)	84 (32)	92 (34)	423
417	[illegible] LAKE	16 (6)	16 (6)	0 (0)	24 (9)	72 (27)	11 (4)	134
418	LAKE OF THE PINES	54 (20)	76 (29)	66 (25)	39 (15)	17 (0)	48 (17)	248
419	LAVON RESERVOIR	21 (8)	29 (11)	3 (1)	84 (32)	100 (38)	21 (7)	258
420	LEWISVILLE LAKE	3 (1)	3 (1)	39 (15)	26 (10)	17 (0)	3 (1)	91
421	LYNDON B JOHNSON LAKE	39 (14)	11 (4)	53 (20)	66 (25)	39 (14)	38 (10)	236
422	[illegible] LAKE	99 (37)	0 (0)	49 (34)	37 (14)	17 (0)	100 (38)	342
423	LAKE [illegible]	82 (31)	91 (33)	71 (27)	95 (36)	39 (14)	63 (23)	441
424	PALESTINE LAKE	54 (20)	32 (12)	63 (24)	53 (20)	48 (17)	51 (19)	362
425	[illegible] RESERVOIR	74 (28)	91 (33)	84 (32)	58 (22)	17 (0)	63 (23)	367
426	SAN [illegible] RESERVOIR	13 (5)	45 (17)	0 (0)	0 (0)	88 (33)	46 (17)	200
427	SAN [illegible] RESERVOIR	59 (22)	39 (15)	68 (26)	76 (29)	17 (0)	63 (23)	322
428	E O SPENCE RESERVOIR	58 (19)	83 (31)	45 (17)	58 (19)	17 (0)	76 (28)	321

[illegible] OF LAKES WITH [illegible] VALUES [illegible] OF LAKES WITH [illegible] VALUES

LAKE ID#	LAKE NAME	[illegible] TOTAL P	[illegible] TMDL %	500> [illegible] SEC	[illegible] CHLOPH	15> [illegible]	[illegible] BOSS [illegible]	TMDL? NO
[illegible]	[illegible]	29 = 119	55 = 211	24 = 99	3 = 12	67 = 254	38 = 150	254
[illegible]	[illegible]	18 = 75	87 = 370	5 = 25	16 = 71	82 = 333	39 = 144	259
[illegible]	[illegible]	80 = 333	37 = 144	87 = 339	82 = 350	17 = 61	51 = 199	372
[illegible]	[illegible]	32 = 129	78 = 289	37 = 144	21 = 89	63 = 244	38 = 150	253
[illegible]	[illegible]	11 = 44	51 = 199	13 = 51	26 = 94	72 = 279	13 = 51	179
[illegible]	[illegible]	39 = 144	34 = 133	61 = 234	45 = 177	17 = 61	21 = 71	217
[illegible]	[illegible]	80 = 339	23 = 71	92 = 359	82 = 317	17 = 61	84 = 333	484
[illegible]	[illegible]	8 = 89	84 = 220	11 = 44	5 = 21	92 = 359	8 = 61	369
[illegible]	[illegible]	59 = 229	21 = 71	58 = 229	61 = 239	46 = 179	63 = 251	311
[illegible]	[illegible]	84 = 329	61 = 229	76 = 294	89 = 344	17 = 61	63 = 251	346
[illegible]	[illegible]	63 = 244	51 = 194	74 = 289	71 = 279	17 = 61	76 = 289	357

[illegible] RANKED BY INDEX VOL.

[illegible]	[illegible] CODE	[illegible] NAME	INDEX VOL
29	[illegible]	[illegible] A JOHNSON LAKE	239
30	[illegible]	[illegible] LAKE	217
31	[illegible]	[illegible] LAKE	209
32	[illegible]	[illegible] RESERVOIR	208
33	[illegible]	[illegible] LAKE	176
34	[illegible]	[illegible] LITTLE [illegible] RESERVOIR	173
35	[illegible]	[illegible]	164
36	[illegible]	[illegible] LAKE	159
37	[illegible]	[illegible] CREEK LAKE	155
38	[illegible]	[illegible] LAKE	139
39	[illegible]	[illegible] LAKE	48

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107 x 10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

[illegible]

APPENDIX D

PHYSICAL and CHEMICAL DATA

APPENDIX E

TRIBUTARY DATA

[illegible]

[illegible]
33 27 [illegible] 3d1 0= 57.0 =
[illegible] =0F=
=0=: T.= 5=1= T=
=0=: =1=0 =0=
AT [illegible] =[5[=F [illegible]
[illegible] 21[illegible]
[illegible] FEET [illegible] CLASS =3

DATE FROM TO	TIME OF DAY	DEPTH FEET	=0035 =07=UMI= =-TOTA= =6=/L	=0625 TOT =.EL =/=6 TOTAL =6=/L	=0613 =/=6 =6=/L	=7471 =6=5-=25 =6=/L =	=2=65 =6=5-=2= =6=/L =
[illegible]	14 30		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14 30		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11 45		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13 50		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	15 25		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10 00		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13 00		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	15 30		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11 47		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13 55		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14 23		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	15 25		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

= VALUE =0=A= T= BE
LESS THAN INDICATED

[illegible] WATER DATA, DATE 74/03/10

[illegible]
33 34 38.0 086 04 25.0 4
[illegible]
40 1.0 [illegible]
[illegible]
[illegible] FT N [illegible] 40 3.0 [illegible]
[illegible]
[illegible] FEET [illegible] 0.455 00

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FROM	OF		[illegible]	N	[illegible]	[illegible]	
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L P	MG/L P
74/12/17	14	20	0.044	1.258	0.020	0.005	0.015
75/01/10	14	20	0.040	0.258	0.005	0.005	0.015
75/02/06	12	35	0.024	0.508	0.014	0.004	0.010
75/03/10	14	00	0.005	0.408	0.015	0.079	0.108
75/04/00	16	10	0.020	0.458	0.038	0.025	0.050

[illegible] VALUE [illegible] TO BE
LESS THAN [illegible]

[illegible]

[illegible]
33 27 27.0 101 05 24.0 4
[illegible]
48 7.5 SMITH TANK
[illegible]
PUMPING STA 2.5 MI W OF CAMP
[illegible] 2111ZA
[illegible] FEET [illegible] CLASS 10

DATE FROM TO	TIME OF DAY	DEPTH FEET	00631 NITRATE TOTAL MG/L	00625 TOT KJEL N MG/L	00610 AMMONIA TOTAL MG/L	00671 PHOS-DIS (MF0) MG/L P	00665 PHOS-TOT MG/L P
74/03/04	11	45	0.845	1.450	0.450	0.805	0.817
74/12/05	14	45	0.843	0.980	1.250	0.827*	0.835
74/11/13	11	95	0.864	1.540	0.960	0.810	0.830
75/01/14	15	00	0.856	1.000	0.940	0.805	0.820
75/02/06	12	10	0.844	0.780	0.810	0.804*	0.810*
75/03/19	13	05	0.865	1.150	0.830	0.80>*	0.816
75/04/08	15	00	0.825	1.250	0.845	0.805	0.810
75/05/15	11	47	0.885	0.480	0.815	0.810	0.810
75/06/12	13	06	0.855	1.750	0.856	0.805	0.820
75/07/04	14	28	0.820	0.750	0.950	0.805	0.820
75/08/27	15	10	0.805	0.480	0.810	0.805	0.830

* VALUE KNOWN TO BE
LESS THAN INDICATED